International Journal on Advanced Science Engineering Information Technology

Vol.9 (2019) No. 5
ISSN: 2088-5334

Innovative Design of the Combined Rocking Horse Toy and Folding Chair for Children

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***Abstract*— Every parent in giving toys to their children must have their criteria, both in terms of safety, unique toy design and durability of the toy product. Therefore, toy companies must be able to develop quality improvement. Toy is considered as a tertiary need for humans, yet its development of innovation is no less important compared to primary and secondary needs, especially rocking horse toy. Its shape and way of playing make it as one of the prominent toy for children and one of the most famous traditional toy. The emergence of modern toy has left the traditional toy in gradual decline and thus worrying its manufacturers. Subsequently, the manufacturers of traditional toy have managed to combine the rocking horse and folding chair so that the folding chair, when the two of its sides being folded, may form a rocking horse. Furthermore, to determine the parameter of design innovation, the Kansei engineering approach has been chosen and using the emotions and needs of the costumers as the basis. Kansei is able to show children's emotions in choosing and playing toys, then applied to the designThere are five Kansei words appeared: secure, interesting, pleasant, dependable, and user friendly. These Kansei words are used as the parameter of design innovation. The value of Z>0.05 on validity test is applicable to all the five words mentioned earlier. This new design is expected to increase the passion of rocking horse toy manufacturers to compete with modern toy companies. Then there is no doubt the design for the toy is also important.**

***Keywords*— rocking horse; folding chair; toys; Kansei engineering.**

I. INTRODUCTION

Sales of product are one of the main support of a company's business continuity [1]; so do children toy producing company. Development and innovation are the ways that tertiary product demand such as children's toy does not decrease and the company remains competitive. Children have a spontaneous and intuitive nature; they tend to choose something visually appealing and in line with their imagination, including in choosing toys [2].

In this case, the role of parents is also needed to accompany children in choosing toys. One of most favorite toys for children is rocking horse; this toy raises children's imagination because of the shape and the way to play it exactly like riding a horse. Parents often worry about safety in this rocking horse, and the short period in using the toy because the child will grow thus, it will be forgotten. In terms of marketing and sales, modern toys are in a state of rapid development far exceeding the traditional toys; this situation makes the traditional toy manufacturers, so do the manufacturer of a rocking horse, they start to concern about business sustainability, and thus product's development and innovation are needed to improve the sales.

The main outline of a rocking horse and folding chair combined toy is its different functions, which the chair serves as an important tool in everyday life while rocking horse only acts as a complementary need for children to play. However, these two products with different purpose of functions are combined and regarded as innovative product design that is expected to raise profit and value in terms of sales, functional value, to increase product's functional age, and still can satisfy consumers both parents and their children. From the innovative design also expected that the toy has quality service which provides a new experience for children in playing rocking horses, capable of becoming a favorite toy, and increase the popularity of traditional toys again.

In the designing process, Kansei engineering method is used to get the criteria in designing a chair which every side can be folded and transformed into a rocking horse. The results of Kansei engineering method in the form of criteria based on consumer's feelings are useful for describing the perceptions, feelings, and response into a design of product [3]. Five Kansei words obtained are secure, exciting, pleasant, dependable, and user-friendly used as a parameter in designing this rocking horse innovation. Those words are obtained from children (users) and parents (supervisors). Data collecting and deriving towards children is different from that of adults, for the random, imaginative, and spontaneous nature of children.

Therefore the way to collect the data is different [4]. One of the advantages of Kansei engineering method is that it can translate consumers' feelings and emotional needs into product design parameter [5]. In this design process is expected that the technique of Kansei engineering method can turn children's unique emotional feelings into the parameters of rocking horse design. To increase the value of product sales, the innovative design is in the form of alarm clock combined with *otok-otok* toy. *Otok-otok* is a kind of traditional toys. Both products have a different function, but can be combined into innovative product design by using Kansei engineering method. Engineering type and product innovation design are expected to be the solutions for toy and watch manufacturers to increase the value of marketing and sales [3]. Sherigan [3] surveyed 25 adult respondents as consumers.

The design of chairs and desks for elementary schools also has been conducted on children as. Anthropometric measurements and percentile applications were performed in this study to obtain the description of the design. To improve user's convenience, precise dimensions and sizes give great and important effects [6]. Kansei engineering also used as the method in innovation design of rocking horse toys and folding chairs that explore consumers' feelings, desires, and expectations. The respondents and consumers are children, and parents or their teachers. The goals and functions of this product innovation are as a rocking horse toy and as a regular chair for children, which is safe and comfortable.

II. Materials and Method

A. Kansei Engineering

Kansei engineering technique is one of the consumer-oriented techniques that read consumer's feelings, emotions, and perceptions to produce words which represent that feeling [7]. The idea in the consumer's mind transformed into the necessary element to design the product; this is one advantage of Kansei engineering. Feelings, psychological and image in the new products become the basis of that Japan origins word's techniques. Attractive image, beautiful appearance, multifunctional, and durable are features that give consumers a good initial impression to buy a product [8]. One goal of the effective design process is to create a good relationship between the product and its users because a good relationship can be interpreted as a consumer's satisfaction and convenience in using the product. It is based on emotional characteristic and gesture showed by the consumer in the form of communicating their thoughts about the product [9].

The actual purpose of all kinds of innovative methods in product development based on consumer needs and wants, so do their feelings and emotions that need to be added by using the Kansei engineering method [10]. Kansei engineering can transform the data based on feelings, emotions, gestures, and experiences verbally expressed by consumers into the mathematical model. This model is linked to the process of product design and physical characteristics. There are four approaches in Kansei engineering, that is:

- Consumer needs of product design are identified by the terms of psychological reaction and ergonomics.
- Applying physical parameters of the design for the proposed design for the consumer to be satisfied and by their requirements.
- Developing Kansei engineering results and applying ergonomic technology for better product design.
- Applying the design according to consumer preferences and needs [5] to improve human prosperity based on physiological and psychological aspects to be applied to a product is one of the aims of Kansei engineering [10].

B. Survey

The number of respondents is 63 children aged between 2 to 5 years, with parents or teachers as a supervisor, directing and assisting with data collection. Data obtained and collected in the village of Margoagung, Sayegan, Yogyakarta city at three early childhood schools/PAUD (early childhood education program). By using Lovin formula, the value of 55 respondents is obtained with trust level 0.05, so the number of respondents is enough.

C. Procedure

The flow of the research is shown in the diagram below:

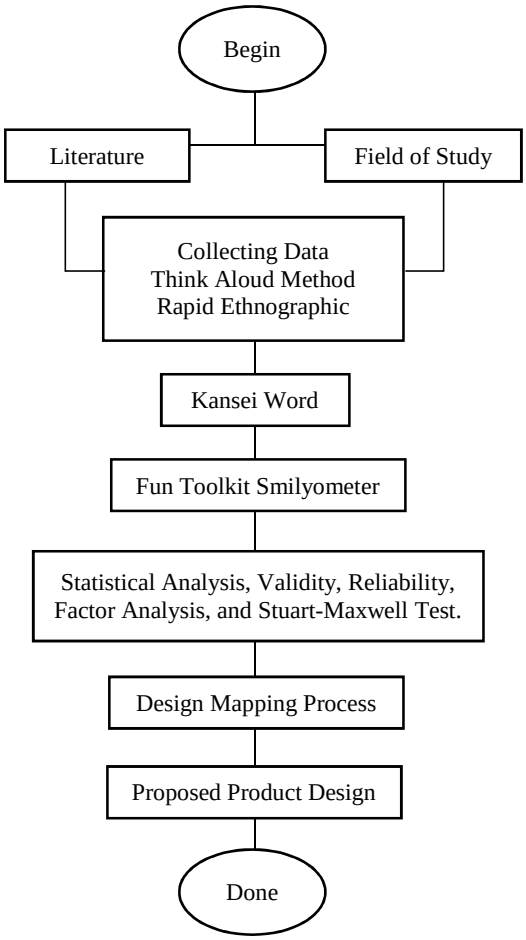

Fig. 1 research flow diagram

This study using the following procedure:

- *Kansei words* obtained by observing and interviewing 55 children as respondents by aged 2-5 years who were guided by teachers or their parents. *Thinking loud* was

one of the techniques used in data collection [11]. Ethnographic techniques were also used by observing children who want, own, and play with rocking horses while accompanied and directed by parents or teachers.

- The Kansei words obtained from the analysis transformation results and direct observation.
- To get children's feelings and detect, according to the semantic differential questionnaire. Who were numerically measured, and questionnaire variables derived from Kansei words. Questionnaires which using Fun Toolkit with a rating scale of a smiley meter [4] on a range of 1-5 filled by parents or supervising teachers, which done so that the data obtained were more accurate with the help of parents or teachers.
- Validity, reliability, factor analysis, and Stuart-Maxwell test were performed as statistical analysis [3].
- The Kansei words are conceptualized in the form of mapping based on its level.
- By taking the anthropometry of children's bodies and the Kansei word derived into account as the background of product design.

III. RESULT AND DISCUSSION

A. Target Market

Identifying the target user of the product that is going to be designed is needed to produce the specifications of new product design that met market interest. The product that is designed in this research is children's to, which is rocking horse. Therefore the target market is children aged 2-5 years. The first thing that becomes the consideration for the consumers is entertainment, games, and basic needs. In every generations and age, lifestyle and needs will be affected by the era where they are growing up and develop. Therefore the design of rocking horse toy must be adjusted with children’s wants according to the era they lived [12].

B. Kansei Word

The observation results provide 23 Kansei words from children and parents respondents. Kansei's words are obtained by think-aloud protocol and ethnography. The Thinking loud technique is carried out by continually observing the character and attitudes of the respondents, including gestures, social interactions, and spontaneous saying showed as a response [13], such as the feeling when playing rocking horses, when imagining about rocking horses, or when they look at a rocking horse figure or image. One of the best ways to get the Kansei word from children is intuitively and randomly showing a rocking horse picture [14]. The benefit of think aloud protocol is not much of an assumption. We can learn the participants' thought from the behavior observed, in this case, is the behavior of children with toys [15]. For the Kansei words to be more accurate, rapid ethnography is also used to derive survey results in the form of words from children respondents guided by teachers and parents.

Respondents are observed by using the ethnographic technique, to obtain new information which used as data analysis. 23 Kansei words are divided and sorted by same meaning and most often chosen categories. These categories aim to determine Kansei's most precise words but still reflect and describe consumer feelings [5], also to avoid and evade words with double meaning, or vague, ambiguous, inarticulate, and confusing words. From this stage the results can be known produce of the five Kansei words that include the needs most and felt useful in the process of designing rocking horses, that is: secure, interesting, pleasant, dependable and user-friendly. Table 1 can describe 23 Kansei words, which then sorted into 5 groups of Kansei words.

TABLE I
KANSEI WORD

Number	Respondent Word	Kansei Word
01	Safe	Secure
02	Controlled	
03	Stable	
04	Exciting	Interesting
05	Horselike	
06	Moving back and forth	
07	Adorable	
08	Interesting	
09	Multicolored	
10	Not monotonous	
11	Entertaining	
12	Appropriate	Pleasant
13	Cottony saddle	
14	Precise size	
15	Strong	Dependable
16	Long-lasting	
17	Wooden material	
18	Not easily broken	
19	Playable	User-friendly
20	Can move	
21	User-friendly	
22	Functional	
23	Can be played inside the house	

Statistically, reliability and validity tests are implemented to these five Kansei words. The correlation of each Kansei word and the total value of the variable show the correlation degree between obtained Kansei words [16].

TABLE II
RELIABILITY AND VALIDITY TEST

Kansei Word	Correlation Coefficient	Cronbach Alpha	Conclusion
Secure	0.478	0.782	Reliable & valid
Interesting	0.582	0.8	Reliable & valid
Pleasant	0.450	0.750	Reliable & valid
Dependable	0.4	0.780	Reliable & valid
User Friendly	0.340	0.770	Reliable & valid

After the step of the validity test, statistical reliability test is done to verify and check the level of reliability. To measure the consistency of each Kansei word obtained is using reliability test. Kansei words data are considered reliable if the Cronbach Alpha coefficient ≥ 0.7 [16]. The value of coefficient correlation and Cronbach Alpha of each word of Kansei showed in table 2. If the correlation value of these five Kansei words obtained is above 0.3, and the value of Cronbach Alpha is above 0.7, then they considered as reliable and valid through reliability and validity test [3]. The analysis factor is done towards Kansei words obtained to see the number of factor groups from words obtained. Table 3 below shows all five Kansei words that have been analyzed and resulted in two groups and categories of factors.

From the factor 1, we can be labeled as *easy* factors which contain *user-friendly*, *pleasant*, and *interesting* while factor 2 that contains *secure* and *dependable* can be labeled as a *safety* factor. *Easy* and *safety* has the highest score in the group and significantly contributed to the Kansei words in the design [3].

TABLE III
FACTORS GROUP

Factor of 1		Factor of 2	
User Friendly	0.811	Secure	0.848
Pleasant	0.453	Dependable	0.930
Interesting	0.418		

C. *Design Mapping*

We can define mapping design as categories classification in mapping out the design by breaking down all target of the product concept that has been planned based from subjective Kansei words with design target parameters derived from the result of analysis and observation [17]. The process of designing products to illustrate the substantial design from folding chairs and rocking horses toys is occupying on the acquired Kansei words. From figure 2 and 3 below explain the mapping of the design process.

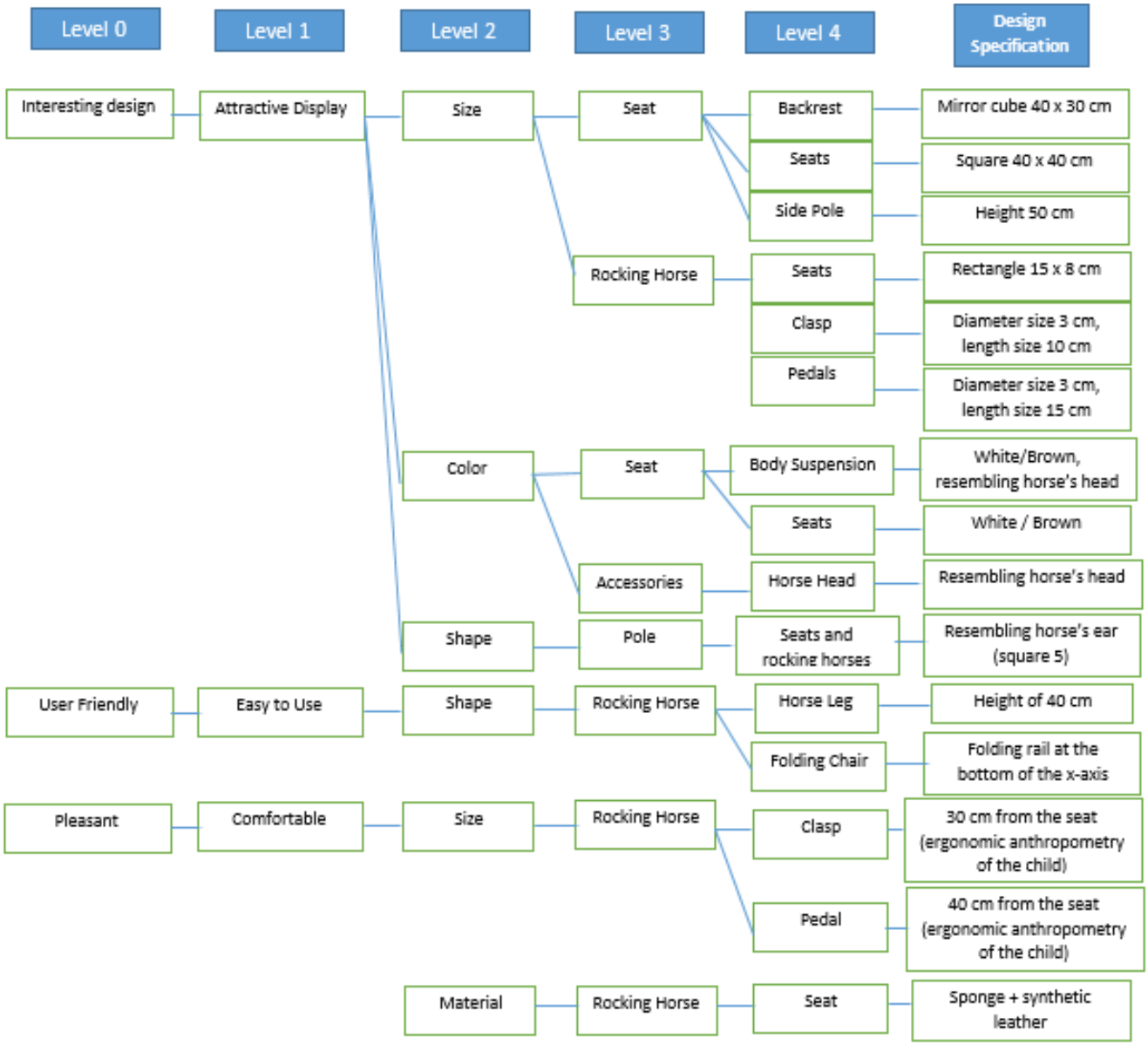

Fig. 2 Design Mapping Process from Factor 1 (Easy)

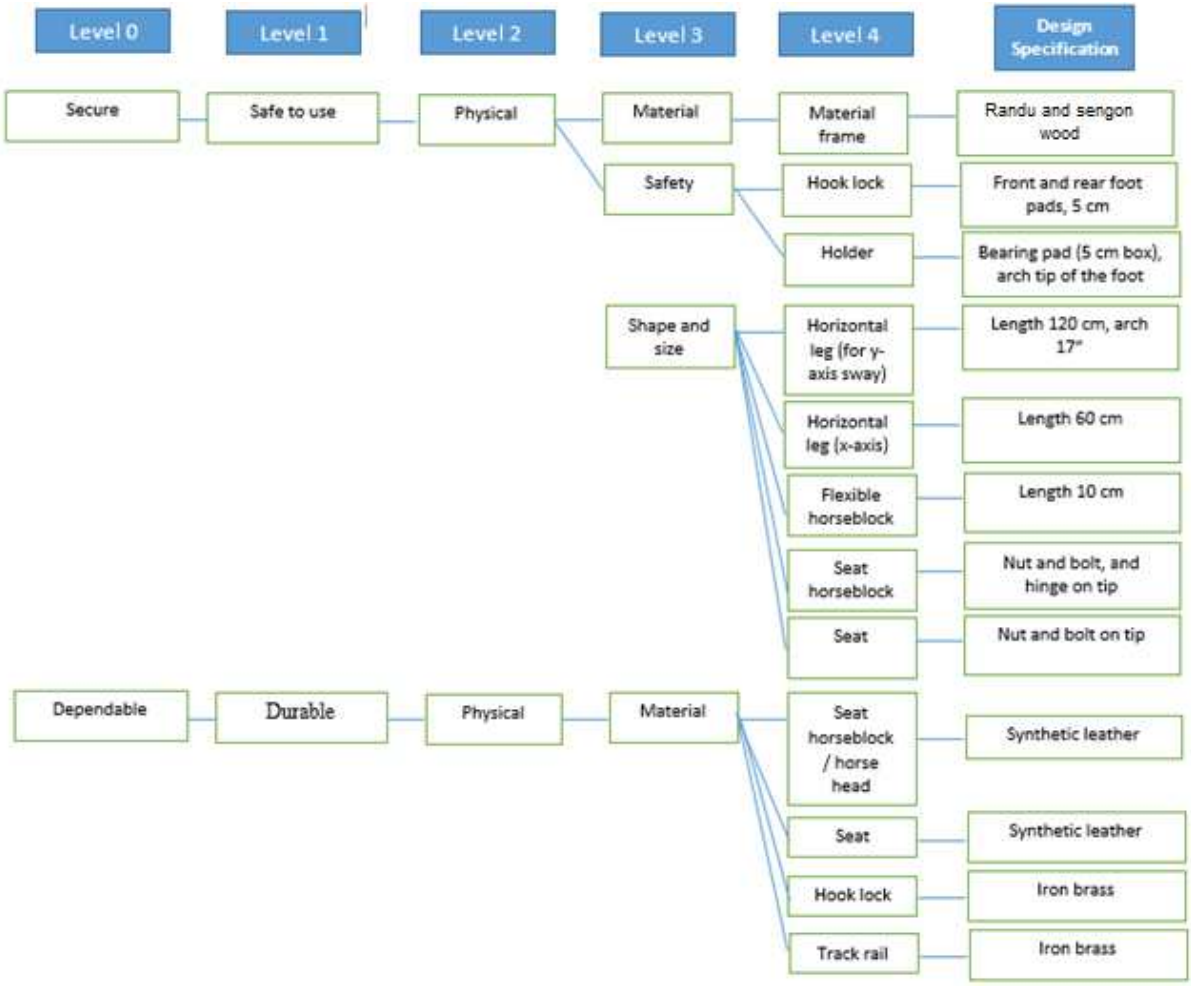

Fig. 3 Design Mapping Process from Factor 2 (Safety)

Figure 2 and 3 above show mapping design process with the physical design specification of a rocking horse combined with folding chairs. Not all of the five Kansei words that are obtained must be taken into detailed specifications, only the most influencing factor which still show all of Kansei's words. The most used is secure, interesting, pleasant, dependable, and user-friendly by the words of Kansei obtained [3].

Figure 2 shows the factor of *easy* and figure 3 shows the specification based on safety factor, both described the rocking horse toys physical design combined with folding chairs in detail depends on the results of five Kansei words. For safety factor in a *secure* and *dependable* category, Kansei words describe to use of teak or mahogany woods, for the design of chair or furniture, wooden material is very durable and good [18]. Security systems, locking hooks on its base and pad holder in its horizontal base make a more stable rocking horse. Also, the size and shape of the x-axis and the curved y-axis are designed based on safety, by the directions from toy makers. Interesting design factors can be realized by chair's shapes which resemble horse's head, followed by chair body that resembles horse's belly when folded, and chair poles in both right and left sides which resemble horse's ear. The attractiveness of the design is also influenced by the using of attractive colors, which will be very influential by taking after the original color of the horse; the color of choice is white and brown. The factor of ease in using the product is manifested in chair legs which uses a rail so it can be folded easily, and at the height of the footrest and legs, which ensures the children to have no trouble in using the toys as they wish, based from children anthropometry.

D. Proposed Design

The proposed design of rocking horse and folding chair depend on the acquired Kansei's word, which is secure, interesting, pleasant, dependable and user-friendly and then transformed into a physical specification by the design mappings then displayed in the proposal design form. Kansei words related to convenience and comfort are applied to the proposed design taking into account anthropometric dimensions or measurements in children, applying dimensional measurements by anthropometry [19]. Based on the obtained Kansei words that are secure, interesting, pleasant, dependable, and user-friendly, the design is proposed and adapted to the specifications of the design mapping. This stage can also be referred as visually displaying the specifications obtained. Figure 2 shows the folding chair in the normal position. With the locking system, the seat in this state will function normally as a seat in general and will not shake/swaying. These chairs can be used by children for their daily activities such as eating, watching TV, or studying. The features which designed

according to the user's feelings are the key comfort from seat and rocking horse design [20].

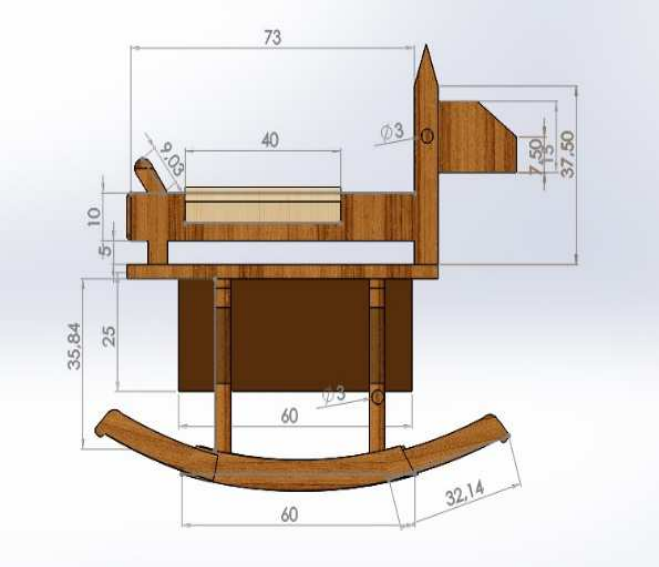

Fig. 4 Proposed Seat Product Design

The safety lock can also be pulled in so that the seat can sway back and forth. That is applied for ease and as an additional feature.

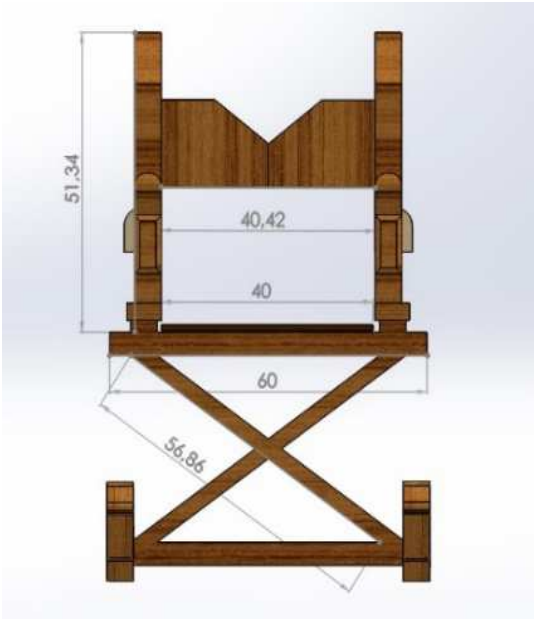

Fig. 5 Proposed Rocking Horse Product Design

The rocking horse toy is formed from seat transformation, as shown in figure 5. Both sides of the normal seat as in figure 2 are folded inside so that the back side is protruding and form a shape like a horse's head. Then, both handholds are merged, resulting in a saddle form of a rocking horse. Therefore it can be fully functioned as a toy. Balance/stability and pressure system in human posture; in this case is children's posture is applied in product design. For the child to play safely and comfortably, the design applies the right natural anthropometry [21]. Knee, shoulders, and elbows height dimension in sitting position, so do lower popliteal, the width of shoulder and hip, and also forward hand reach are several conditions applied in the design process.

TABLE IV
ANTHROPOMETRIC AND PERCENTILE

No	Element	Detail	Percentile	Length
01	Elbow height, Sitting	height of chair handhold	5th	15 cm – 20 cm
02	Shoulder height, Sitting	height of seat horseblock	5th	50 cm
03	Knee height, popliteal width, Sitting	feet height of the seat	5th	40 cm
		height of the rocking horse pedals and chairs	5th	40 cm
04	Functional Grip Reach	distance between the handheld	5th	30 cm (allowance)
05	Hip width Sitting	seat width	95th	40 cm (allowance)
06	Shoulder width	width of seat horseblock	95th	40 cm (allowance)

For the design that aims for comforts, the elbow's height dimension in sitting position is using the 5 percentile for the handhold height, and the shoulder's height dimension using the 5 percentile (5 cm allowance). For determining the height of the seat; popliteal sitting knees are used for seat height (40-45 cm), then the distance between chairs and rocking horse saddle is 40 - 45 cm or allowance, hence with the dimension of 5 percentile and 5-8 cm allowance, children with small body can still use it and play easily. 95 percentile is used for the user's comfort and convenience, with the width of the hips in sitting position for seat width is 40 cm. The dimension of the shoulder and hip width are applied to the width of the chair horseblock with 90 percentile and 40 cm size. The length of handhold is using 5 percentile, applied to the distance between handrails by 30 cm for children convenience while playing the rocking horse [6].

Fig. 6 3D proposed design product

The implementation of allowance on the design aims to ensure that the measurements are not stiff; however, either the excess or shortfall in frequency may cause discomfort in its use [6]. Determination of percentile in the design is expected to be appropriate because boys and girls have significant size differences at each age studied, especially for the length of the hand and their height because it will be correlated with the percentile, therefore allowance in the measurement is needed [22].

The Kansei word "*pleasant*" can be attributed to the use of good materials applied in product design [23]. In this chairs design, for example, is using synthetic leather all over the chair, including its horse-block part, and foams on rocking horses to keep the children comfortable while playing the rocking horse toy. The use of wood material also becomes the reason in designing the product for a more secure and sturdy quality. The Kansei word "*interesting*" is based on the children's experience in seeing horses, either in drawings or the sight of a real horse [24]. This is applied to the product proposal design by mapping the visual product in the form of a horse painted in brown and white to make it look attractive. The similarity of the shape is as close as possible to the real animal so that when children play with it, they feel like riding the actual animal. The Kansei word "*secure*" is based on the manual safety lock in front and back side of rocking horse's base, so that part does not loose easily back to the chair legs. Safety systems and warranty for consumers are providing guarantee and satisfaction for long periods, also help to raise the manufacturer's revenue [25]. The locking system on the product uses hook made of a brass chain with a size of 5 cm. Safety system for children playing time with rocking horses is also manifested by applying a 5 x 5 cm of screen block on all four bases. The block is keeping the shaking and swaying safe and not excessive.

E. Design Validation

In this study, a Stuart-Maxwell marginal homogeneity test is used for design validation. This test is conducted to see the difference between the proposed designs depend on the Kansei word collected from consumers.

TABLE IV
THE RESULT OF STUART-MAXWELL TEST (MARGINAL HOMOGENEITY)

Kansei Words	Z Value
User-Friendly	0.212
Pleasant	0.567
Interesting	0.688
Secure	0.262
Dependable	0.835

The design can be said as valid by the consumer if the value achieves Z> 0.05 [3]. Table 5 shows the results of the Stuart-Maxwell test for the five Kansei words, where the value obtained for the smallest is 0.201, and the highest is 0.824. Hence the proposed design can be said to be valid.

IV. CONCLUSIONS

Twenty three Kansei words are found at the process of designing a combined rocking horse toy and folding chairs, focusing on 5 words; secure, interesting, pleasant, dependable, and user-friendly. Then two factors obtained from 5 Kansei words are transform or grouped. The first factor is easy, shown by Kansei words interesting, user-friendly, and pleasant; and the second factor is safety from Kansei's word of secure and dependable. From 5 Kansei words are obtained used as the basic ground in the process of design innovation of combined rocking horse and folding chairs to get the suggested design that is in line with customer demands. The Kansei words are transformed into a specific form of design with mapping design and shown in the proposed visual design. The results of design validation show the value of Z> 0.05 for fives Kansei words, based on consumer demand and preferences that are indicating the design's validity.

ACKNOWLEDGMENT

The authors would like to say our gratitude to the Industrial Engineering Faculty of the Indonesian Islamic University's Industrial Engineering Postgraduate program for the support, trust and appreciation given during the research, so that the authors are able to conduct and develop new research that is expected to provide a lot of benefits for the research world. We also welcome and appreciate the cooperative efforts, teamwork, and a good attitude for all individuals who help and contributed to the achievement of this objective of the research.

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